



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 02:13 PM UTC

PDB ID : 201L / pdb_00002011
Title : HOW AMINO-ACID INSERTIONS ARE ALLOWED IN AN ALPHA-HELIX
OF T4 LYSOZYME
Authors : Heinz, D.W.; Matthews, B.W.
Deposited on : 1993-10-12
Resolution : 2.00 Å (reported)

This is a Full wwPDB X-ray Structure Validation Report for a publicly released PDB entry.

We welcome your comments at validation@mail.wwpdb.org

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

with specific help available everywhere you see the ⓘ symbol.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4-5-2 with Phenix2.0
Mogul : **NOT EXECUTED**
Xtrriage (Phenix) : 2.0
EDS : **NOT EXECUTED**
Buster-report : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

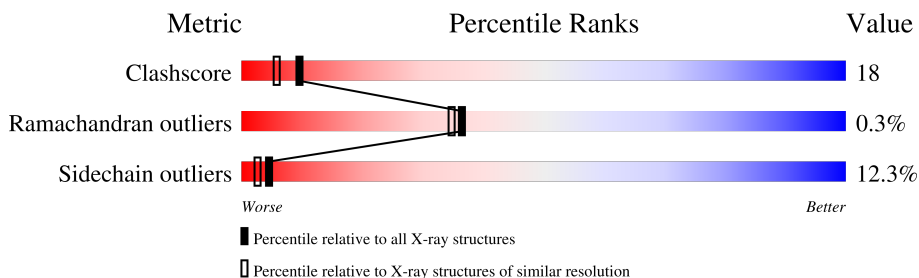
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.00 Å.

Percentile scores (ranging between 0-100) for global validation metrics of the entry are shown in the following graphic. The table shows the number of entries on which the scores are based.



Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria respectively. A grey segment represents the fraction of residues that are not modelled. The numeric value for each fraction is indicated below the corresponding segment, with a dot representing fractions $\leq 5\%$

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	A	166	
1	B	166	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 2763 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called T4 LYSOZYME.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	164	1309	825	239	240	5	0	0	0
1	B	166	1326	835	242	244	5	0	0	0

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	48A	HIS	-	insertion	UNP P00720
A	48B	PRO	-	insertion	UNP P00720
A	54	THR	CYS	conflict	UNP P00720
A	97	ALA	CYS	conflict	UNP P00720
B	48A	HIS	-	insertion	UNP P00720
B	48B	PRO	-	insertion	UNP P00720
B	54	THR	CYS	conflict	UNP P00720
B	97	ALA	CYS	conflict	UNP P00720

- Molecule 2 is BETA-MERCAPTOETHANOL (CCD ID: BME) (formula: C₂H₆OS).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	
2	B	1	Total	C	O	S	0	0
			4	2	1	1		
2	B	1	Total	C	O	S	0	0
			4	2	1	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	49	Total	O	0	0
			49	49		
3	B	71	Total	O	0	0
			71	71		

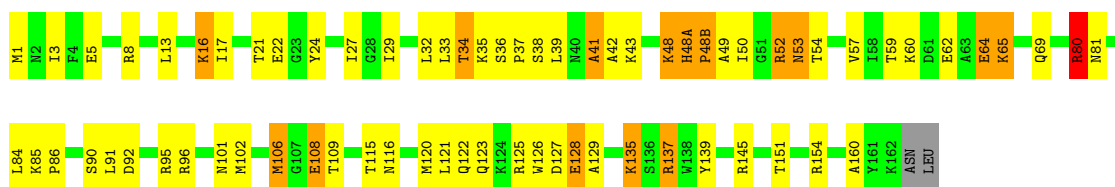
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-coded according to the number of geometric quality criteria for which they contain at least one outlier: green = 0, yellow = 1, orange = 2 and red = 3 or more. Stretches of 2 or more consecutive residues without any outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

Note EDS was not executed.

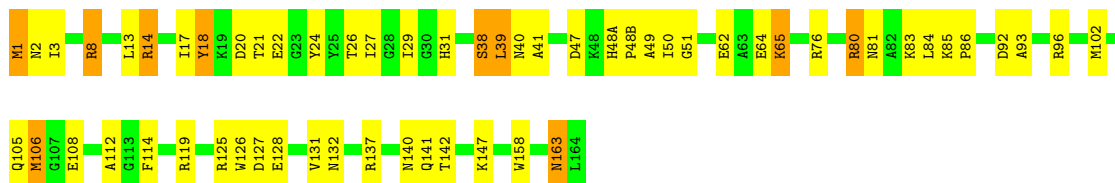
- Molecule 1: T4 LYSOZYME

Chain A:  56% 33% 9% ..



- Molecule 1: T4 LYSOZYME

Chain B:  64% 30% 6%



4 Data and refinement statistics

EDS was not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	55.23Å 54.20Å 59.10Å 90.00° 103.45° 90.00°	Depositor
Resolution (Å)	(Not available) – 2.00	Depositor
% Data completeness (in resolution range)	(Not available) ((Not available)-2.00)	Depositor
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.33 (at 1.89Å)	Xtrriage
Refinement program	TNT	Depositor
R, R_{free}	0.182 , (Not available)	Depositor
Wilson B-factor (Å ²)	17.8	Xtrriage
Anisotropy	0.175	Xtrriage
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
Total number of atoms	2763	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.83% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: BME

The Z score for a bond length (or angle) is the number of standard deviations the observed value is removed from the expected value. A bond length (or angle) with $|Z| > 5$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
1	A	1.16	0/1331	1.52	13/1794 (0.7%)
1	B	1.19	0/1348	1.64	17/1816 (0.9%)
All	All	1.18	0/2679	1.58	30/3610 (0.8%)

There are no bond length outliers.

All (30) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	140	ASN	CA-CB-CG	-10.18	102.42	112.60
1	B	126	TRP	N-CA-C	7.20	120.05	111.33
1	B	142	THR	CA-C-N	7.20	126.73	119.24
1	B	142	THR	C-N-CA	7.20	126.73	119.24
1	A	92	ASP	CA-CB-CG	-6.74	105.86	112.60
1	B	163	ASN	CA-CB-CG	6.40	119.00	112.60
1	B	114	PHE	CB-CA-C	-6.40	102.18	111.91
1	B	106	MET	N-CA-C	6.09	120.74	112.88
1	A	96	ARG	N-CA-CB	6.08	119.06	110.12
1	B	105	GLN	CA-C-N	-5.89	113.42	122.60
1	B	105	GLN	C-N-CA	-5.89	113.42	122.60
1	B	93	ALA	N-CA-C	5.81	118.09	111.11
1	A	126	TRP	N-CA-C	5.64	117.91	111.02
1	A	154	ARG	N-CA-C	5.54	117.00	111.07
1	A	106	MET	N-CA-C	5.45	120.60	113.30
1	B	18	TYR	CA-CB-CG	-5.39	104.19	113.90
1	A	36	SER	N-CA-CB	5.39	117.31	110.04
1	B	17	ILE	N-CA-CB	5.36	117.32	110.13
1	A	121	LEU	N-CA-CB	5.28	117.97	110.16
1	B	40	ASN	N-CA-C	-5.25	105.73	111.82
1	B	31	HIS	CA-CB-CG	-5.22	108.58	113.80
1	A	80	ARG	CB-CA-C	5.22	118.80	110.09

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	37	PRO	CA-C-N	-5.20	115.86	122.77
1	A	37	PRO	C-N-CA	-5.20	115.86	122.77
1	B	108	GLU	CA-C-N	5.16	127.62	120.29
1	B	108	GLU	C-N-CA	5.16	127.62	120.29
1	A	101	ASN	CA-CB-CG	5.12	117.72	112.60
1	A	41	ALA	N-CA-C	-5.05	105.67	111.07
1	B	140	ASN	N-CA-C	5.04	116.77	111.28
1	A	129	ALA	N-CA-C	-5.03	105.69	111.07

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts [i](#)

In the following table, the Non-H and H(model) columns list the number of non-hydrogen atoms and hydrogen atoms in the chain respectively. The H(added) column lists the number of hydrogen atoms added and optimized by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1309	0	1333	57	0
1	B	1326	0	1350	38	0
2	B	8	0	10	0	0
3	A	49	0	0	5	0
3	B	71	0	0	3	0
All	All	2763	0	2693	95	0

The all-atom clashscore is defined as the number of clashes found per 1000 atoms (including hydrogen atoms). The all-atom clashscore for this structure is 18.

All (95) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:52:ARG:HH12	1:A:54:THR:HA	1.35	0.92
1:A:50:ILE:HD11	1:A:62:GLU:HB3	1.56	0.85
1:B:14:ARG:HG3	1:B:18:TYR:CE1	2.18	0.79
1:A:50:ILE:CD1	1:A:62:GLU:HB3	2.13	0.76
1:A:16:LYS:HG3	1:A:57:VAL:HG22	1.68	0.75
1:B:48(A):HIS:CG	1:B:48(B):PRO:HD2	2.22	0.73
1:A:52:ARG:NH1	1:A:54:THR:HG22	2.04	0.72

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:122:GLN:HB3	3:A:446:HOH:O	1.91	0.70
1:A:8:ARG:HH12	1:A:64:GLU:CG	2.04	0.69
1:B:76:ARG:NH1	3:B:488:HOH:O	2.24	0.69
1:B:119:ARG:HH11	1:B:119:ARG:HG3	1.58	0.68
1:A:116:ASN:O	1:A:120:MET:HE3	1.95	0.67
1:A:123:GLN:HG3	3:A:446:HOH:O	1.95	0.66
1:A:24:TYR:CZ	1:A:35:LYS:HD3	2.31	0.66
1:A:52:ARG:NH1	1:A:54:THR:HA	2.08	0.66
1:A:24:TYR:CE2	1:A:35:LYS:HD3	2.32	0.64
1:B:65:LYS:HD2	3:B:234:HOH:O	1.96	0.64
1:B:49:ALA:HB1	1:B:65:LYS:HD3	1.79	0.64
1:A:52:ARG:HH11	1:A:52:ARG:HG3	1.63	0.63
1:A:52:ARG:HH12	1:A:54:THR:CA	2.10	0.62
1:B:92:ASP:O	1:B:96:ARG:HG3	2.00	0.62
1:A:52:ARG:HH11	1:A:52:ARG:CG	2.12	0.61
1:B:125:ARG:NH2	1:B:128:GLU:OE1	2.29	0.60
1:A:8:ARG:NH1	1:A:64:GLU:OE2	2.35	0.59
1:B:50:ILE:HD13	1:B:62:GLU:HG2	1.86	0.58
1:B:85:LYS:HB3	1:B:86:PRO:HD3	1.84	0.58
1:A:34:THR:CG2	1:A:42:ALA:HA	2.34	0.57
1:A:49:ALA:HB1	1:A:65:LYS:HG2	1.86	0.57
1:A:85:LYS:N	1:A:86:PRO:HD2	2.19	0.57
1:B:39:LEU:O	1:B:39:LEU:HG	2.03	0.57
1:B:85:LYS:N	1:B:86:PRO:HD2	2.20	0.57
1:A:48(A):HIS:CE1	1:A:49:ALA:H	2.20	0.56
1:B:1:MET:HE3	1:B:158:TRP:HB3	1.88	0.55
1:A:151:THR:HG21	1:A:160:ALA:HB2	1.89	0.55
1:A:125:ARG:HB3	1:A:128:GLU:HG3	1.87	0.55
1:A:16:LYS:CG	1:A:57:VAL:HG22	2.35	0.55
1:A:81:ASN:HD22	1:A:108:GLU:HG3	1.72	0.53
1:B:137:ARG:HG2	1:B:141:GLN:OE1	2.08	0.53
1:A:48(A):HIS:CG	1:A:48(B):PRO:HD2	2.43	0.53
1:A:65:LYS:O	1:A:69:GLN:HG3	2.08	0.53
1:A:39:LEU:CD2	1:A:43:LYS:HE3	2.39	0.52
1:A:80:ARG:O	1:A:80:ARG:HG2	2.09	0.52
1:B:1:MET:HG3	1:B:2:ASN:H	1.74	0.52
1:A:59:THR:OG1	1:A:62:GLU:HG3	2.09	0.52
1:A:102:MET:O	1:A:106:MET:HG2	2.10	0.52
1:B:21:THR:OG1	1:B:22:GLU:N	2.40	0.51
1:B:48(A):HIS:ND1	1:B:48(B):PRO:HD2	2.25	0.51
1:B:21:THR:OG1	1:B:22:GLU:HG2	2.10	0.50

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:33:LEU:C	1:A:34:THR:HG22	2.36	0.50
1:A:49:ALA:HB1	1:A:65:LYS:HD3	1.92	0.50
1:A:102:MET:HB3	1:A:106:MET:HE3	1.91	0.50
1:B:83:LYS:HD3	1:B:112:ALA:HB1	1.94	0.49
1:B:119:ARG:HH11	1:B:119:ARG:CG	2.26	0.49
1:A:48(A):HIS:ND1	1:A:49:ALA:N	2.44	0.48
1:B:125:ARG:HH21	1:B:128:GLU:CD	2.19	0.47
1:B:38:SER:HB3	1:B:41:ALA:CB	2.45	0.47
1:B:38:SER:HB3	1:B:41:ALA:HB2	1.96	0.47
1:A:85:LYS:N	1:A:86:PRO:CD	2.78	0.47
1:B:80:ARG:HD2	3:B:439:HOH:O	2.15	0.46
1:A:52:ARG:HG3	1:A:53:ASN:N	2.31	0.46
1:A:116:ASN:C	1:A:120:MET:HE3	2.40	0.46
1:B:26:THR:HG22	1:B:27:ILE:N	2.30	0.46
1:B:29:ILE:O	1:B:29:ILE:HG22	2.15	0.45
1:B:47:ASP:O	1:B:51:GLY:HA2	2.16	0.45
1:A:151:THR:HG21	3:A:341:HOH:O	2.15	0.45
1:B:3:ILE:HD12	1:B:3:ILE:O	2.17	0.45
1:B:81:ASN:HB3	1:B:84:LEU:HB2	1.98	0.45
1:B:13:LEU:C	1:B:14:ARG:HG2	2.42	0.45
1:A:48:LYS:HE3	1:A:48:LYS:HB2	1.66	0.45
1:B:8:ARG:HH21	1:B:64:GLU:CD	2.25	0.44
1:A:24:TYR:HB3	1:A:32:LEU:HD11	1.99	0.44
1:A:48(B):PRO:HD3	3:A:499:HOH:O	2.17	0.44
1:A:135:LYS:HG2	3:A:456:HOH:O	2.18	0.44
1:A:139:TYR:C	1:A:139:TYR:CD1	2.95	0.44
1:A:52:ARG:NH1	1:A:54:THR:CA	2.76	0.43
1:A:108:GLU:HG2	1:A:109:THR:N	2.33	0.43
1:B:20:ASP:OD1	1:B:22:GLU:HB2	2.18	0.43
1:A:81:ASN:HD22	1:A:108:GLU:CG	2.31	0.43
1:A:34:THR:HG21	1:A:42:ALA:HA	2.00	0.43
1:A:54:THR:HB	1:A:57:VAL:O	2.18	0.43
1:B:85:LYS:N	1:B:86:PRO:CD	2.82	0.43
1:B:1:MET:HG3	1:B:2:ASN:N	2.31	0.43
1:B:1:MET:HB2	1:B:1:MET:HE2	1.42	0.42
1:A:145:ARG:HH11	1:A:145:ARG:HD2	1.61	0.42
1:A:38:SER:O	1:A:41:ALA:HB3	2.20	0.42
1:A:81:ASN:HB3	1:A:84:LEU:HB2	2.01	0.42
1:A:13:LEU:HD13	1:A:29:ILE:HD11	2.01	0.41
1:A:137:ARG:O	1:A:137:ARG:HG3	2.19	0.41
1:B:22:GLU:CB	1:B:24:TYR:CD2	3.04	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:102:MET:HE2	1:A:106:MET:HE3	2.02	0.41
1:A:8:ARG:HH12	1:A:64:GLU:HG2	1.83	0.41
1:A:17:ILE:HG12	1:A:27:ILE:HD12	2.03	0.41
1:B:18:TYR:CD2	1:B:18:TYR:C	2.99	0.41
1:B:102:MET:HE2	1:B:106:MET:CE	2.51	0.41
1:A:91:LEU:HD22	1:A:95:ARG:HB3	2.02	0.40

There are no symmetry-related clashes.

5.3 Torsion angles [i](#)

5.3.1 Protein backbone [i](#)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	162/166 (98%)	156 (96%)	5 (3%)	1 (1%)	21	17
1	B	164/166 (99%)	157 (96%)	7 (4%)	0	100	100
All	All	326/332 (98%)	313 (96%)	12 (4%)	1 (0%)	36	35

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	115	THR

5.3.2 Protein sidechains [i](#)

In the following table, the Percentiles column shows the percent sidechain outliers of the chain as a percentile score with respect to all X-ray entries followed by that with respect to entries of similar resolution.

The Analysed column shows the number of residues for which the sidechain conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	A	137/139 (99%)	115 (84%)	22 (16%)	2	1
1	B	139/139 (100%)	127 (91%)	12 (9%)	10	6
All	All	276/278 (99%)	242 (88%)	34 (12%)	4	3

All (34) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	3	ILE
1	A	5	GLU
1	A	16	LYS
1	A	21	THR
1	A	22	GLU
1	A	34	THR
1	A	48	LYS
1	A	48(A)	HIS
1	A	48(B)	PRO
1	A	52	ARG
1	A	53	ASN
1	A	60	LYS
1	A	64	GLU
1	A	65	LYS
1	A	80	ARG
1	A	90	SER
1	A	108	GLU
1	A	127	ASP
1	A	128	GLU
1	A	135	LYS
1	A	137	ARG
1	B	1	MET
1	B	8	ARG
1	B	14	ARG
1	B	38	SER
1	B	39	LEU
1	B	65	LYS
1	B	80	ARG
1	B	127	ASP
1	B	131	VAL
1	B	132	ASN
1	B	147	LYS
1	B	163	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	141	GLN
1	B	140	ASN
1	B	163	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

Mogul was not executed - this section is therefore empty.

5.5 Carbohydrates [i](#)

Mogul was not executed - this section is therefore empty.

5.6 Ligand geometry [i](#)

Mogul was not executed - this section is therefore empty.

5.7 Other polymers [i](#)

Mogul was not executed - this section is therefore empty.

5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

6 Fit of model and data

6.1 Protein, DNA and RNA chains

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.